



NOAA FISHERIES

Grade Level
9-12

Materials

- Coat hangers
- Plastic grocery bags
- Tape
- Construction Paper
- Other craft materials (string, pipe cleaners, etc.)
- Cardboard
- Scissors
- 1 bag of colorful goldfish (juvenile red snapper)
- 1 bag of orzo pasta (small fish)
- 1 bag of elbow pasta (juvenile fish)
- ¼ bag of penne pasta (sharks)
- 4-5 tablespoons sprinkles
- 1 large shallow container
- Copies of handouts 1 and 2

Audio/Visual Materials

- Projector
- Computers with Internet

Seating Arrangement
Groups of two or three

Key Words

- Bycatch
- Endangered Species List
- Non-target species
- Trawl
- Sustainability

Bycatch Reduction Devices

For use with Fish Watch at www.fishwatch.gov



Focus

- Bycatch reduction devices

Focus Questions

- What is bycatch and how does it impact marine species?
- How can fishermen and scientists minimize bycatch?

Learning Objectives

- Consider the pluses, minuses, and interesting elements (PMI strategy) as it relates to methods and techniques for fishing bigeye tuna
- Explain the concept of bycatch and why it is a problem
- Discuss ways to minimize effects of bycatch

Background Information

"Bycatch" is a term used to refer to the unintentional capture of non-target species of fish, marine mammals, sea turtles, and seabirds during fishing.

Problems related to bycatch include:

- Impedes or prolongs recovery of animals on the Endangered Species Act list of threatened and endangered species
- Prolonged recovery of overfished stocks and exacerbates overfishing conditions
- Waste of ocean resources

National Science Education Standards

Grades 9-12

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard C: Life Science

- Behavior of organisms

Content Standard E: Science and Technology

- Abilities of technological design
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives

- Environmental Quality

Ocean Literacy Essential Principles

Essential Principle 6

The ocean and humans are inextricably connected.

Fundamental Concept b

From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Fundamental Concept e

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution and

- Waste of time for fishermen due to increased sorting time, bait loss, and fishing gear damage
- Possible closures of entire fisheries if bycatch levels are too high

Bycatch has long been recognized as a global issue. Bycatch occurs because fishing methods are not perfectly selective for the target species (including targeted size range and/or sex), or because incidental take of marine mammals, sea turtles, or seabirds may occur as a result of fishing activities. Bycatch may also occur when regulatory restrictions prohibit retention of particular species, sexes, or size ranges. Therefore, some bycatch occurs in commercial fisheries, and higher rates of bycatch occur in fisheries with less selective fishing methods and practices.

What's Being Done?

For over 25 years NOAA's National Marine Fisheries Service (NMFS) has been conducting research, implementing fishery observer programs, and establishing various measures to monitor and reduce bycatch. Bycatch can be reduced primarily through a combination of developing and then switching to more selective fishing gear and methods, and reducing or changing fishing effort (in time, geographic areas, or within the water column). Research to develop more selective fishing gear is ongoing, and includes innovative new designs such as Turtle Excluder Devices or other methods of allowing non-target species to find their way out of a trap or net.

NMFS and the fishing industry have made significant progress in modifying fishing gear and practices to minimize bycatch and protected species interactions in federally managed fisheries, including the development of bycatch reduction devices and turtle excluder devices in Atlantic and Gulf of Mexico trawl fisheries, requirement of "pingers" for gillnets in Northeast fisheries (to alert marine mammals to the gear), development of escape vents in trawls in Alaskan and Northwest fisheries, and modifications to pelagic longline off Hawaii and the East Coast, including requirements for circle hooks.

Programs implemented to reduce bycatch generally result in lower levels of bycatch, although the magnitude will vary. For example, seabird bycatch in Alaska dropped a great deal after NMFS started requiring seabird avoidance measures including streamer lines in 1997. Streamer lines are long strips of plastic attached to longlines that flap in the wind and scare seabirds off of bait as the longlines are set in ocean waters. According to NMFS estimates, seabird bycatch in Alaska groundfish fisheries have decreased by 80% since streamer lines have been used by Alaska longline vessels.

Shrimping in the Gulf of Mexico

Shrimp remains one of our favorite types of seafood in the United States. Shrimp is low in saturated fat and is a very good source of protein, selenium, and vitamin B12. The commercial shrimp fishery is one of the most economically important fisheries in the southeast. The 2010 commercial harvest of brown shrimp was worth nearly \$150 million.

Nearly 97 percent of the brown shrimp harvested in the United States comes from the Gulf, mainly from Texas and Louisiana. Brown shrimp are available

Fundamental Concept g

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean.

Essential Principle 7

The ocean is largely unexplored.

Fundamental Concept c

Over the past 40 years, use of ocean resources has increased significantly; therefore, the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations.

Fundamental Concept d

New technologies, sensors and tool are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles

fresh and frozen year-round. Commercial fishermen harvest shrimp with trawls. Shrimp trawlers tow cone-shaped nets through the water near the ocean floor. The nets are wide in the front and taper toward the back, where the captured shrimp and any incidentally caught species are concentrated.

Shrimp are essentially an “annual crop” – most shrimp do not survive longer than 2 years. Although scientists monitor shrimp abundance to ensure the stock is healthy, it’s not as an important consideration for fishery managers as with other seafood species. Instead, managers consider historic harvest amounts and fishing rates in developing a management strategy for the fishery. They also look at the amount of surviving parents and environmental conditions, such as weather and water temperatures. As long as environmental conditions are favorable, shrimp are very productive and can rebound from low abundance one year to high abundance the next.

Although shrimp populations are fairly resilient to fishing pressure, commercial shrimp fisheries can impact the abundance of other species, including sea turtles and finfish such as red snapper. To reduce this bycatch, shrimp trawlers must have bycatch reduction devices (BRDs), which are designed to retain shrimp but allow fish to exit the net. Scientists monitor shrimp effort as a proxy for the amount of bycatch taken. If shrimp effort exceeds certain thresholds, managers can close some areas to shrimp trawling at certain times to control bycatch.

Shrimp fishermen must also comply with federal sea turtle conservation requirements, including the use of Turtle Excluder Devices (TEDs). A TED is a grid of bars with an opening at either the top or bottom of the trawl net. The grid is fitted into the neck of a shrimp trawl. Small animals such as shrimp can pass through the grid, but it stops large animals such as sea turtles and they can escape through the opening, relatively unharmed. When properly installed and maintained, TEDs effectively reduce sea turtle deaths. In 2010 and 2011, NOAA recorded a spike in the number of sea turtle strandings in the Gulf of Mexico, and analyses suggested many turtles stranded because of interactions with the trawl fishery. Managers, enforcement officers, and the shrimp industry are working to ensure proper compliance with TED requirements to reduce sea turtle bycatch in the southeastern shrimp fishery.

Learning Procedure

1. Before beginning this lesson, mix together the goldfish crackers and all sizes of pasta and pour them into the large shallow container. Tell students that the container represents the ocean with a variety of organisms living in it.
2. Design a key with images that shows which species each of the materials represents, and project it on the board so students can refer to it.
3. Allow students time to read about brown shrimp on www.fishwatch.gov.
4. Introduce the term “bycatch reduction device” or “BRD” by showing students the following videos:
 - stateofthecoast.noaa.gov/com_fishing/bycatch.html (2 minutes – takes a minute to load)

- dfw.state.or.us/images/video_gallery/bycatch_reduction_device.asp
(2.5 minutes)

5. Divide students into small groups and tell them they are going to trawl for shrimp today. Explain that shrimp are represented by the elbow pasta. Explain that each group will be in charge of building their own trawl net with a BRD. Explain that trawls are large nets that are dragged on the bottom of the ocean floor to catch the shrimp. Show students the following website, so that they can envision how a trawl net might be designed with a BRD.
georgiaseagrant.uga.edu/article/bycatch_reduction/

6. Distribute Student Handout 1 and the construction materials. Allow students time to construct their trawl nets and brainstorm BRDs.

7. Explain to students that they will get three turns to trawl for shrimp. After each turn, they will sort through their catch, noting the number of individuals in each species caught (all species should be returned to container after students have recorded their catch results). Distribute Student Handout 2. Students should record their catch results. They will be given time to modify their BRD between each trawl. The goal is to reduce bycatch of non-target species at each trial.

8. Have each group report their catch statistics to the rest of the class after each trial. Point out the number of non-targeted species that were caught. Once trials are completed, students should answer the analysis questions on Student Handout 2. Discuss their answers to the student worksheet questions. When discussing question 3, be sure to point out that most often bycatch dies. Bycatch costs fishermen time and money, harms endangered and threatened species, affects marine and coastal ecosystems, and makes it more difficult for scientists to measure the effect of fishing on the stock's population, and for managers to set sustainable levels for fishing. Preventing and reducing bycatch is an important part of ensuring sustainable living marine resources and coastal communities (NOAA Bycatch Report).

9. Explain that fishermen are supposed to report their catches to NOAA Fisheries Service to help fisheries managers keep track of fish populations to ensure their sustainability. Data from fishermen is one tool of many tools used to monitor fisheries. Ask only one or two student groups to "report" their catches to the NOAA Fisheries Service.

10. Discuss how the removal of species other than shrimp can impact the ecosystem and sustainability of each and all of the species.

11. Have students select another species from the Seafood Profiles section of www.fishwatch.gov, read about bycatch of that species, investigate the gear that results in bycatch of that species, and then design and test their bycatch reduction devices for the gear.

The Bridge Connection

www.vims.edu/bridge

Use the search function to search for "bycatch" to access lesson plans and additional resources.

The “Me” Connection

Journal on the following:

Bycatch can have significant social, environmental, and economic impacts.

Connections to Other Subjects

Mathematics, Language Arts, Environmental Policy

Evaluation

Assessment could include students’ understanding of the concept of bycatch and bycatch reduction devices, their data analysis, content of their products from the bycatch reduction device design activity, and participation in class discussions.

Extensions

1) Incorporate more mathematics into this activity by having students determine the mean, median, and mode for each species caught. They can then compare their answers and analyze the data for any relationship to the BRD designs.

2) Have students research the connection between shrimping and the overfishing of Red Snapper in the Gulf of Mexico. Direct them to the following site:

www.fishwatch.gov/seafood_profiles/species/snapper/species_pages/red_snapper.htm

Additional Resources

NOAA State of the Coast

stateofthecoast.noaa.gov/com_fishing/bycatch.html

NOAA Fisheries Service – Bycatch Reduction and Engineering Program

www.nmfs.noaa.gov/bycatch.htm

NOAA Fisheries Office of Protected Resources - Fisheries

Interactions/Protected Species Bycatch

www.nmfs.noaa.gov/pr/interactions/

NOAA Fisheries Feature – Magnuson-Stevens Act

www.nmfs.noaa.gov/msa2007/

Rhode Island Sea Grant Fact Sheet - Bycatch

seagrant.gso.uri.edu/factsheets/Bycatch.html

FAO Gear Types -

www.fao.org/fishery/geartype/search/en

NOAA Research: Sea Grant Programs Strike Balance between Protecting Species and Protecting Economies

www.oar.noaa.gov/spotlite/archive/2011/articles/sea-grant.html

Making a Shrimp Trawl Net

1. Begin by making your trawl net. Stretch hanger to into diamond shape (see picture).
2. Secure the edges of the recycled plastic grocery bag to the coat hanger with tape, creating a “net.”



3. It is now time to think about the various organisms that your shrimp trawl net will come into contact with and how you can avoid bycatch. As a group, examine the additional materials (cardboard, construction paper, tape, scissors, etc.) that are available. Begin brainstorming and designing your BRDs to limit your bycatch.

Trawling for Shrimp

	TRIAL 1		TRIAL 2		TRIAL 3	
Name of Species	Number Caught	% of total catch	Number Caught	% of total catch	Number Caught	% of total catch
Shrimp						
Coral						
Turtle						
Invertebrates						
Red Snapper						
	Describe BRD modifications made:		Describe BRD modifications made:		Describe BRD modifications made:	

Analysis

1. Determine the percentage of each species caught.
2. What percentage of the catch was non-target species, or bycatch?
3. What do you think happens to the non-target species?
4. How successful was your team at reducing non-targeted species with your BRD?
What issues did your team face?